

Claims

5 1. Navigation system for performing and assisting surgical operations, in particular in the area of neurosurgery and ear-nose-throat medicine,

10 - wherein the system comprises an image database for preoperatively prepared nuclear-spin or computer tomography (CT or MR) images,

15 - a personal computer or control computer with monitor for image data processing and display,

- a tracking device for determining the momentary position of an instrument and for the derivation or real-time redrawing of representations of the patient's anatomy on the basis of the images stored in the image database, as well as

20 - means for extracting anatomical structures from the raw data sets of the preoperative images and for making these structures available in the form of visualizable 3D data sets;

25 characterized by

- a transmitter to generate a specified constant DC magnetic field in the navigation environment as well as a pointer navigation instrument with an integral magnetic-field sensor, such that the magnetic-field sensor and the constant-field transmitter form the tracking device and the magnetic-field sensor detects its own position or the associated position of the instrument by direction-oriented field-strength measurements, and

30 - means for the menu-guided control of the system, wherein by movements of the pointer navigation instrument outside the operation field but within the navigation environment activate or deactivate proposed menus or control measures, and wherein furthermore the moment of switching is determined by the magnetic-field sensor's crossing a spatial distance or becoming situated at a boundary, and control commands are initiated or confirmed by a switch or key in the instrument.

2. Navigation system according to Claim 1,
characterized in that by way of an image processing module of
the personal computer a three-dimensional processing of the
computer-tomography and nuclear-spin-tomography data from the

5 subject is carried out, with the consequence that the data so
obtained provide an image to be used for planning the operation
and therapy that is identical to the findings from the
craniotomy.

3. Navigation system according to Claim 2,
10 characterized in that by means of the image-processing module
anatomical structures can be selected from the complete data
sets according to their properties or surroundings, and on the
basis of a predetermined segmentation strategy discrete data
sets are produced.

15 4. Navigation system according to one of the preceding claims,
characterized in that the transmitter to generate the DC
magnetic field of the tracking device is disposed at the
operating table or a head support provided there, but outside
the operation field, as a result of which a fixed, reproducible
20 positional relationship is produced between the organ of the
patient that is to be navigated and the transmitter, regardless
of the position of the operating table in space.

25 5. Navigation system according to one of the claims 2 to 4,
characterized in that the magnetic-field sensor sends out
signals from which the position and/or direction of movement of
the pointer navigation instrument can be derived on the basis
of the specified constant magnetic field and its orientation,
which signals can both be displayed on the monitor and used to
control the reloading and updating functions of the image
30 processing module.

6. Navigation system according to one of the preceding claims,
characterized in that an additional magnetic-field sensor is
provided, such that this sensor can be attached to the subject,
preferably to the head, in order to detect changes in location
5 and orientation with respect to the constant-field transmitter.

7. Navigation system according to Claim 6,
characterized in that the output signals from the second
magnetic-field sensor are sent to the control computer as
corrective data, in order to specify a coordinate system that
10 is quasi-dynamic or alterable with reference to the source
alteration.

8. Marking device or fiducial to produce image data for a
database by means of nuclear-spin and/or computer tomography
and to detect the position of a subject and assign coordinates
15 for surgical operations with the assistance of a navigation
system according to the preceding claims, comprising
a flat carrier that can be attached to the subject by means of
an adhesive surface as well as a contrast-marking substance
within a container that can be separated from the carrier,
20 characterized in that

- the carrier is constructed as an at least partially
flexible body with a catch knob substantially centred in
and projecting from the side away from the adhesive
surface,
- 25 - the contrast-marking substance is contained in a housing
that substantially comprises a hollow cylinder, such that
the underside of the housing has a concave shape or is
recessed and on the underside of the housing a catch
receptacle is provided, such that object curvatures can be
30 compensated by the shape of the underside of the housing.

9. Marking device according to Claim 8,
characterized in that the cylindrical housing comprises a
removable housing lid, preferably made of a transparent
plastic, so that the marking substance can be inspected and
exchanged.

10. Marking device according to Claim 8 or 9,
characterized in that the marking substance for nuclear-spin
tomography is a liquid or a gel, which is situated in a
container having the form of a sphere or closed cylinder, such
that the outside diameter of the sphere or cylinder corresponds
substantially to the inside diameter of the cylindrical housing
with catch receptacle.

11. Marking device according to one of the claims 8 to 10,
characterized in that a closed initialization element is
provided, the dimensions and underside configuration of which
correspond to those of the cylindrical housing, such that the
initialization element on its lid side has a marking depression
in the same position as the middle point or centre of gravity
of the contrast-marking substance or the spherical or
cylindrical container.

12. Marking device according to one of the claims 8 to 11,
characterized in that the cylindrical housing and the
initialization element are made of plastic material, and the
carrier preferably comprises a film coated on one side with
adhesive.

13. Pointer for a tracking device of a navigation system for
performing and assisting surgical operations, with an
encapsulated sensor disposed in an elongated handpiece housing
as well as a contact tip partially projecting out of the
housing,
characterized in that the encapsulated sensor is rigidly
connected to the contact tip or to a receptacle for a contact

tip or insertion aid by means of an element with openings substantially opposite one another, such that the element with sensor and contact tip disposed in their respective openings is mounted quasi-cardanically so as to be yielding and stress-free with respect to the handpiece housing, and the connecting element is made of a plastic that is resistant to deformation and thermostable or of titanium.

5 14. Pointer according to Claim 13,
characterized in that in the wall of the handpiece housing a
10 signal key is disposed in a vapour- and liquid-tight manner.

15. Pointer according to Claim 13 or 14,
characterized in that at the end of the housing opposite the contact tip, i.e. opposite the distal end of the housing, is situated a vapour- and liquid-tight cable outlet, such that the
15 connecting element and the cable outlet are connected to the housing by external couplings.

16. Pointer according to one of the claims 13 to 15,
characterized in that the connecting element is disposed with at least its sensor-receptacle opening within the housing, such
20 that between the connecting element and the inside of the housing an annular gap is formed and to seal the gap between connecting element and housing or external coupling and housing at least one flexible sealing ring is provided.

25 17. Navigation system,
characterized by a combination of features according to the characteristics of Claims 1 and 13.